Remarks

Entry of this amendment, reconsideration of the application and allowance of all claims are respectfully requested. Claims 1-35 remain pending.

Initially, Applicants gratefully acknowledge the indication of allowability of claims 8-10, 22 & 34 if rewritten into independent form including all the limitations of the base claim and any intervening claims. Presently, these dependent claims have not been rewritten into independent form since the amended independent claims from which they ultimately depend are believed to be in condition for allowance for the reasons stated below.

<u>35 U.S.C. §112:</u>

The Office Action presents a 35 U.S.C. §112, second paragraph, rejection to independent claims 1, 11, 16, 23, 28-30 & 35 as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. This rejection is respectfully traversed and reconsideration thereof is requested.

As used in the present application, "density" means the density of the printed output averaged over a basic cell. The density resulting from a particular basic cell pattern of output intensities can be measured, for example, by a densitometer when the input is such that the basic cell, in the area measured by the densitometer, has the particular basic cell pattern, or when the particular basic cell pattern is present in all output cells within the area of the printed output measured by the densitometer. Density is determined by the number and relative overlap of dots within the basic cell. (See paragraph [0052] of the specification.) FIG. 14 illustrates for comparison basic cell pattern growth examples of <u>output intensities</u> for a prior art approach and for an approach in accordance with the present invention, where a resultant number of densities larger than n + 1 is attained (where "n" is the number of possible dots within the basic halftone cell) for a constant input. (Although FIG. 14 does not specifically show this, the patterns of output intensities shown in the "invention examples" columns of FIG. 14 will yield different densities, when printed, even though some of them produce the same number of dots.) FIG. 14 of the present application depicts in two columns "prior art" examples of output intensities for a basic cell, and in the remaining two columns "invention examples" of output intensities attainable for a basic cell employing the concepts of the present invention. The numeric values 0

– 19 correlate to the "invention example" and document that at least twenty different densities are attainable using the invention, for constant input intensity, over the full range of input intensities. Please note that a basic cell receives constant input when every input intensity that affects the given basic cell is identical. An example of this is contained within FIG. 15, which shows all 9 input intensities that will affect a given basic cell are equal to the value 8. (Additionally, please note that, in the method described in Abe, a single basic cell is affected by only one input intensity, so that each basic cell always receives constant input.)

With the above as background, Applicants respectfully traverse the example provided at page 2 of the Office Action in support of the 35 U.S.C. §112, second paragraph, rejection. Specifically, it is noted in the example that "the maximum number of densities per basic cell for any given input intensity is 4 (for an input intensity of 4, four different output densities, number "6" through "9", are shown in the "invention example"). First, Applicants respectfully submit that for any given constant input intensity, only one output intensity is provided in accordance with the concepts of the present invention. This is discussed further below in connection with the substantive rejection to the independent claims. By increasing the number of densities (see FIG. 14), attainable within a basic cell for a constant input intensity within the full range of constant input intensities (0 to K), Applicants increase the number of densities for a basic halftone cell.

In accordance with Applicants' recited invention, the number of densities per basic cell is greater than $(1 + n \times (L - 1))$ for a constant input intensity within the full range of constant input intensities (0 to K). Thus, the number of densities in Applicants' invention relates to the number of pels within a basic cell (n), and the number of output intensity levels (L). There is no relation to the input intensity levels (K), only that the input intensity be constant within the basic cell to evaluate the density characterization of Applicants' independent claims. The amendments submitted to the independent claims in this regard clarify that the improvement in the maximum number of densities per each basic cell is achieved with Applicants' invention across the full range of constant input intensities (i.e., from 0 to K).

For all the above reasons, Applicants respectfully submit that the independent claims particularly point out and distinctly claim the subject matter which Applicants regard as the invention. As such, reconsideration and withdrawal the 35 U.S.C. §112, second paragraph, rejection thereto is requested.

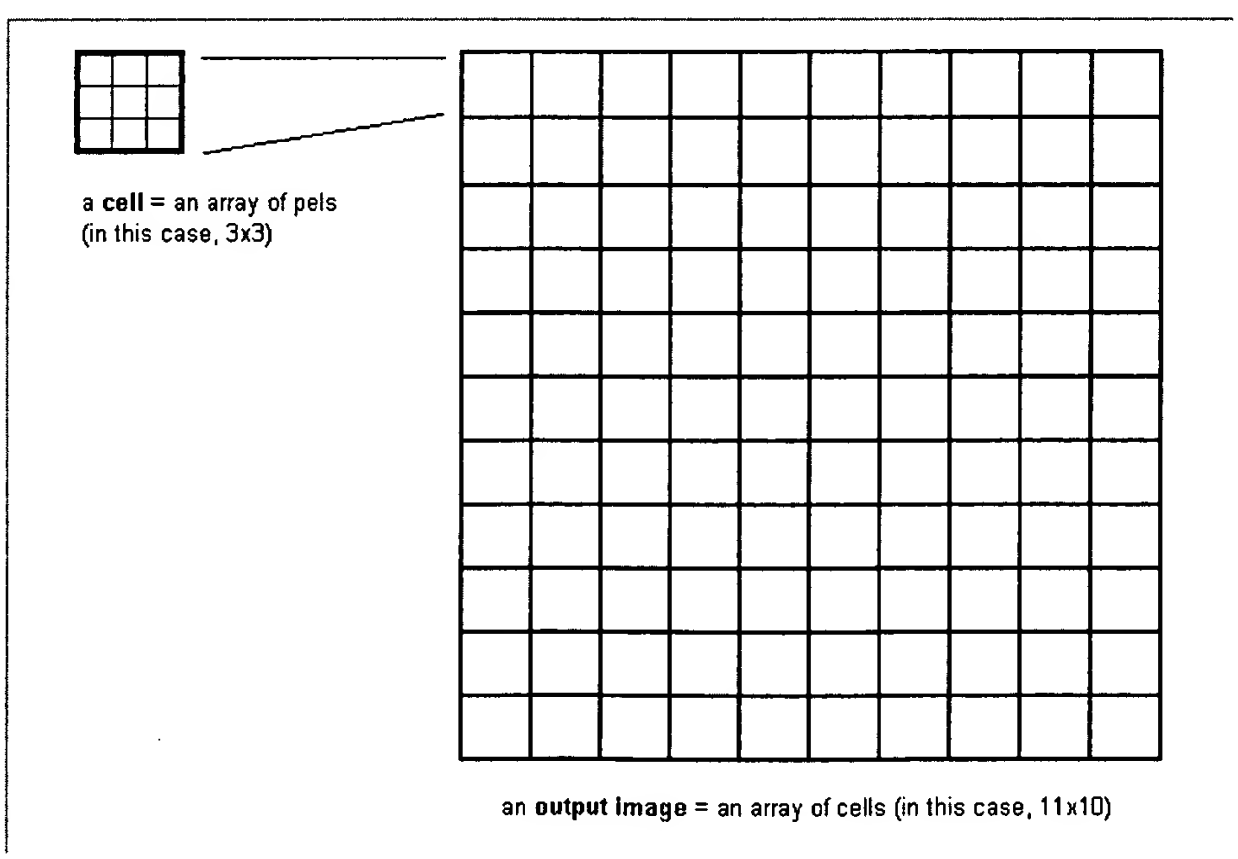
35 U.S.C. §112, first paragraph:

The Office Action also presents a 35 U.S.C. §112, first paragraph, rejection to claim 23 as allegedly failing to comply with the written description requirements. Responsive thereto, Applicants have herein amended claim 23 to delete the "means for" language and insert therefor "a halftoning processor". Support for this amendment can be found, e.g., in FIG. 6 of the application, and the supporting discussion thereof. Based upon this amendment, the rejection is believed moot, and reconsideration and withdrawal thereof is requested.

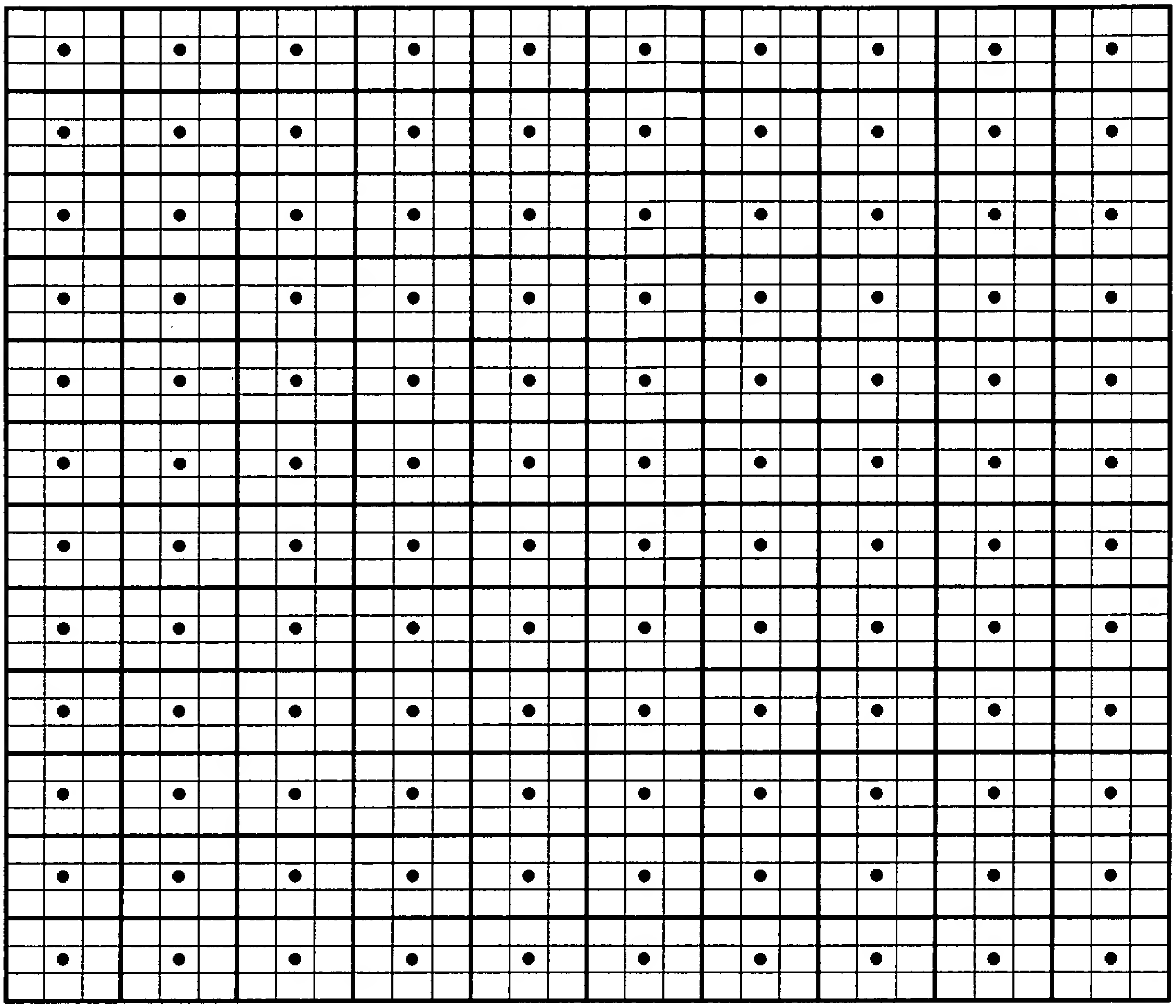
35 U.S.C. §102:

In the Office Action, claims 1-3, 11, 12, 16-18, 23, 24, 28, 30-32 & 35 were rejected under 35 U.S.C. §102(b) as being anticipated by Abe (U.S. Patent No. 5,805,305; hereinafter Abe). This rejection is respectfully, but most strenuously, traversed to any extent deemed applicable to the claims presented herewith, and reconsideration thereof is requested.

To facilitate an understanding of the present invention, the following simplified examples are provided. Two methods for halftoning are summarized below, i.e., a first method referred to as a "one-to-basic cell" method, and a second method referred to as a "one-to-one" method. Both methods group output pels into cells. In Abe's figures, a cell is a 3 x 3 array of pels. An output image is composed of a large number of these cells, arranged in a two-dimensional array.



A key characteristic of the "one-to-basic cell" technique is that each intensity value in the input data array is used to determine the printed/non-printed pattern of all pels in an entire cell, where a cell comprises multiple pels. The following figure is meant to illustrate this.



● = a value in the input data array

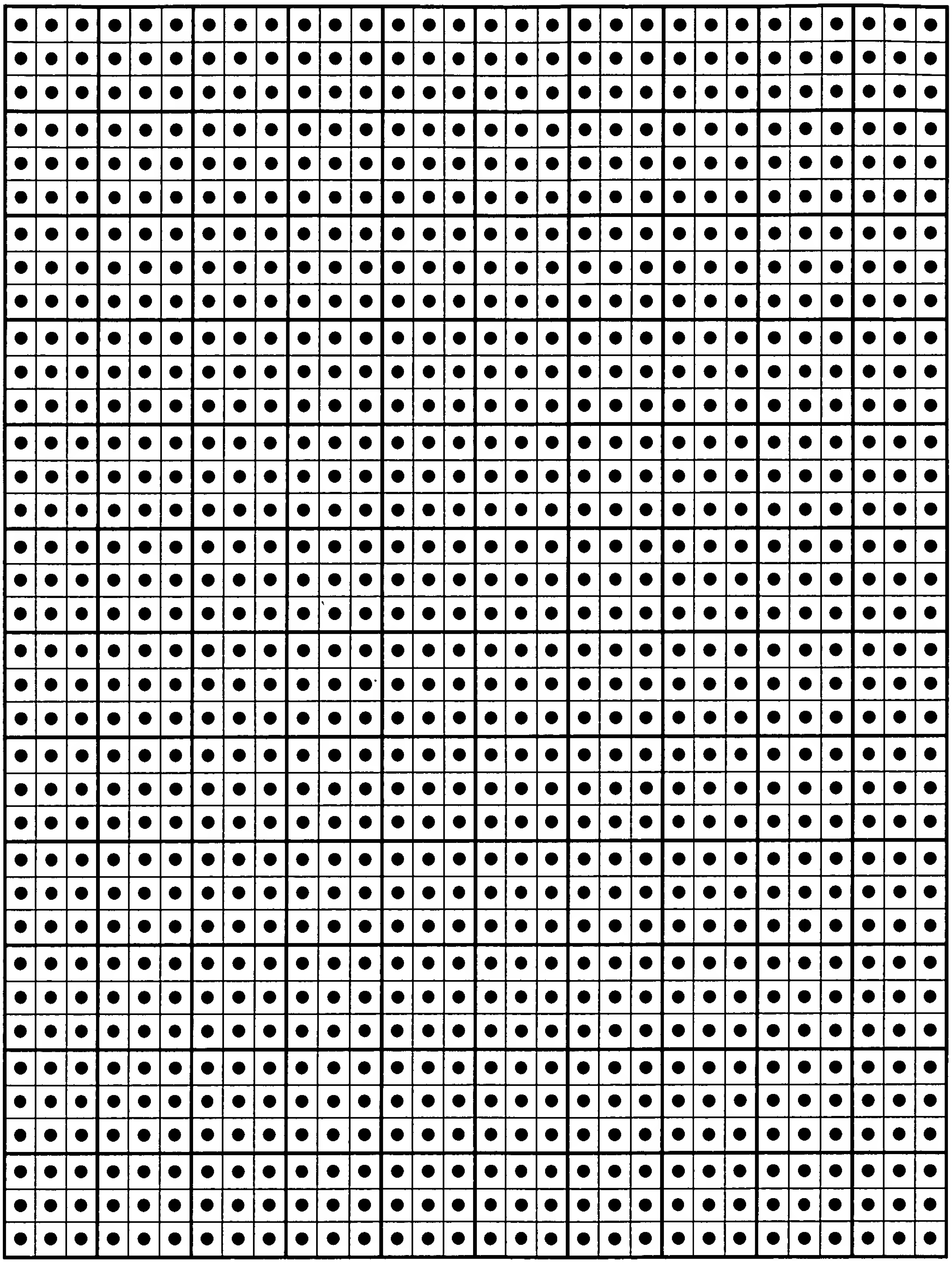
In the **first method**, each value in the input data array is used to determine whether **each pel in an entire cell** is printed or not-printed. In the example being used, this means that each value in the input array is being used to determine whether each of 9 pels are printed or not-printed. In the real world, this number can be much higher, as cells frequently contain much more than 9 pels.

Thus, with this technique, each value in the input data array is used to determine whether each pel in an entire cell is to be printed or not printed. In the example provided, this means that each value in the input array is used to determined whether each of nine pels are printed or not printed. In the real world, this number can be much greater, as cell frequently contain many more than nine pels.

The image to be printed is represented as an array of numbers, with one number corresponding to the location of each **cell**. For instance, in order to print a 4-inch x 6-inch photograph in a 6-inch x 9-inch area on a piece of paper, using a printer with a resolution of 600 dots-per-inch (i.e., 600 pels per inch). Assuming that the 6-inch x 9-inch are on the piece of paper is the "output image area", and assuming that a cell is 3-pel x 3-pel square, the printer could print 200 cells per inch. Accordingly, the printer would print 1200 x 1800 "samples" of the image, one corresponding to the location of each cell that the printer will print in the "output image area". If the 4-inch x 6-inch photograph is scanned to create this input, it would be scanned at the rate of 300 samples per inch. (Note: 300 = 1200/4 = 1800/6). This means that each sample would have a numerical value representative of the density of the image in a square $1/300^{th}$ of an inch on each side. Assuming the collection of all 2.16 million number is the "input data array". (Note: 1200 x 1800 = 2,160,000).

For each of the 1200 x 1800 numbers contained in the "input data array", the halftone algorithm selects one for a collection of "pel patterns" (e.g., in Abe, Fig. 5, for an input value of 0.822, a dither pattern with a "0" in the center and a "1" in the other 8 locations will be selected and printed.)

A key characteristic in a "one-to-one" technique is that each number in the input data array is used to determine whether a single pel within a cell is printed or not printed. This means the input data array of the "one-to-one" method is larger than the input data array of the "one-to-basic cell" technique by a factor equal to the number of pels in a cell. Because of this, the input data array in the "one-to-one" method contains more information about the image than the input data array in the "one-to-basic cell" approach. This is illustrated by the following figure:

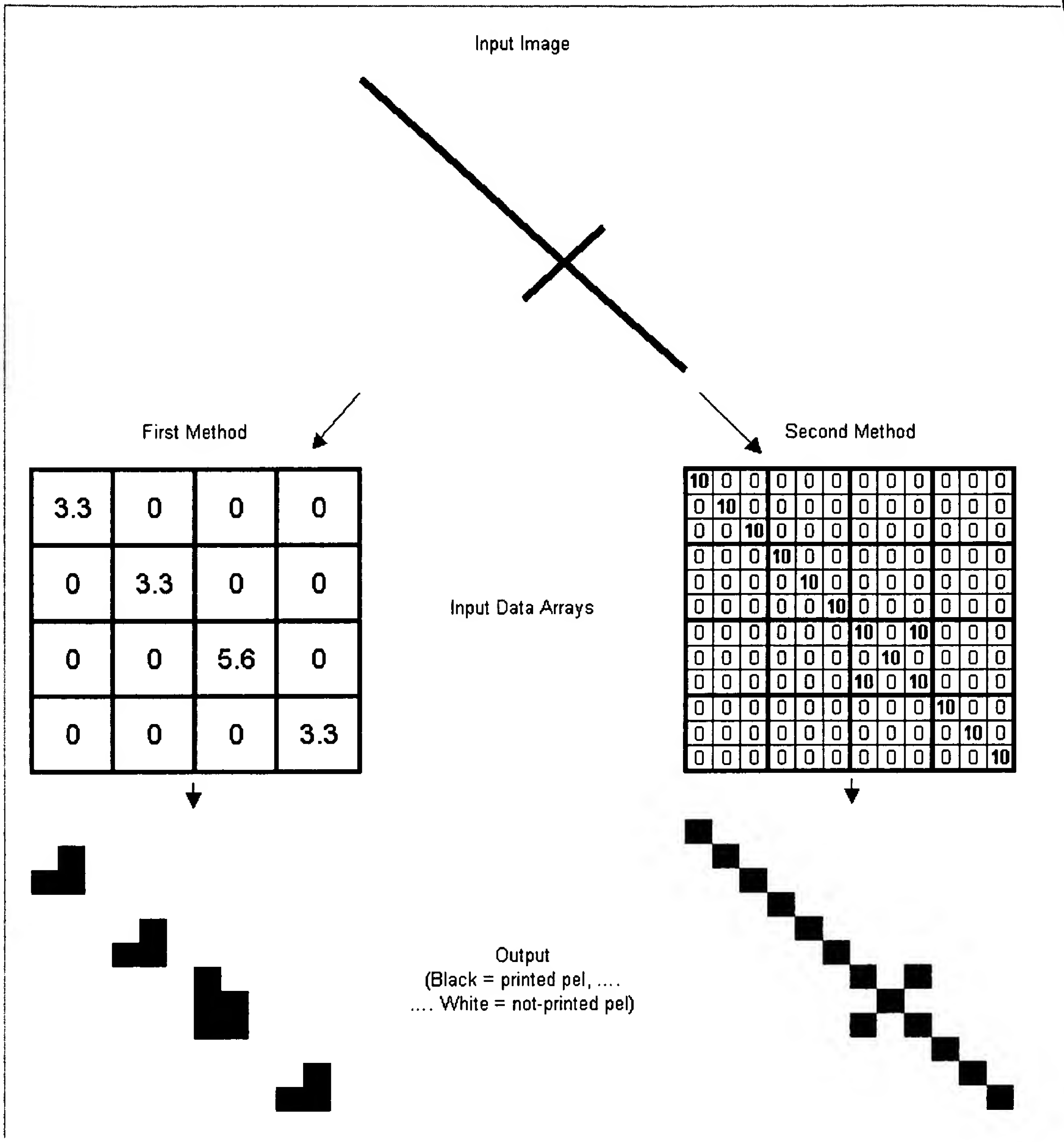


● = a value in the input data array

In the **second method**, each value in the input data array is used to determine whether a **single pel in a single cell** is printed or not-printed.

In the "one-to-one" approach, each value in the data input array is used to determine whether a single pel in a single cell is printed or not printed. In the example used, this means that each value in the input array is used to determine whether a corresponding pel of the nine pels of the cells is printed or not printed. Again, in the real world, this number can be much higher.

Further, it should be noted that with the Applicants' implementation of the "one-to-one" method (such as described in Applicants' invention) as the level of constant input intensities increase, a pel that has transitioned from "not-printed" to "printed", can then transition back to "not-printed". This is an ability that is missing from the applied art. By way of example, the basic cells in FIG. 14 are actually in order of increasing density. Note that, in this figure, some of the pels transition from "not-printed" to "printed", then back to "not-printed" and then to "printed" again. To understand the advantage of this approach, a non-constant input is selected, and the following figures illustrate how the "one-to-one" approach preserves more detail of the image than does the "one-to-basic cell" approach (such as described by Abe).



3.3	0	0	0
0	3.3	0	0
0	0	5.6	0
0	0	0	3.3

10	0	0	0	0	0	0	0	0	0	0	0
0	10	0	0	0	0	0	0	0	0	0	0
0	0	10	0	0	0	0	0	0	0	0	0
0	0	0	10	0	0	0	0	0	0	0	0
0	0	0	0	10	0	0	0	0	0	0	0
0	0	0	0	0	10	0	0	0	0	0	0
0	0	0	0	0	0	10	0	10	0	0	0
0	0	0	0	0	0	0	10	0	0	0	0
0	0	0	0	0	0	10	0	10	0	0	0
0	0	0	0	0	0	0	0	0	10	0	0
0	0	0	0	0	0	0	0	0	0	10	0
0	0	0	0	0	0	0	0	0	0	0	10

Thus, a basic difference between the present invention and the Abe teachings is that Abe describes a "one-to-basic cell" approach, while the present invention claims a "one-to-one" approach. By this paper, Applicants have amended independent claims 1, 11, 16, 23, 28, 29, 30 & 35 to more clearly point out and distinctly claim this difference. Specifically, various independent claims now recite that the "number of pels of the first plurality of pels is equal to the number of pels of the second plurality of pels." In these claims, the first plurality of pels is received as input data, and wherein the second plurality of pels are grouped into basic cells as output data. Further, each independent claim is amended to specify that multiple (e.g., n) pels of the first plurality of pels contribute to the output intensities of the n pels within each basic cell.

Thus, in accordance with Applicants' recited invention, there is a "one-to-one" mapping between the number of input pels and the number of output pels. Support for this language can be found throughout the application as filed. For example, reference FIG. 15 of the application, and the supporting discussion thereof. Thus, no new matter is added to the application by any amendment presented.

In one aspect, Applicants' claimed invention is directed to a technique for halftoning (e.g., claim 1). This technique includes receiving input data comprising a first plurality of pels having a first plurality of intensities, wherein the first plurality of intensities (Iin) are chosen from K intensity levels. The first plurality of pels are converted into a second plurality of pels having a second plurality of intensities, wherein the second plurality of intensities (Iout) are chosen from L intensity levels, wherein $L < K$, and wherein the number of pels of the first plurality of pels is equal to the number of pels of the second plurality of pels. At least some pels of the second plurality of pels are grouped into at least one basic cell. Each basic cell includes n pels of the second plurality of pels. The technique is further characterized by a maximum number of densities per each basic cell being greater than $(1 + n \times (L - 1))$ for a full range of constant input intensities (i.e., 0 to K) (Iin), and each intensity out (Iout) is chosen without reference to an intensity out of a neighboring pel, and n pels of the first plurality of pels contribute to the output intensities of the n pels within each basic cell.

It is well settled that there is no anticipation of a claim unless a single prior art reference discloses: (1) all the same elements of the claimed invention; (2) found in the same situation as the claimed invention; (3) united in the same way as the claimed invention; and (4) in order to perform the identical function as the claimed invention. In this instance, Abe fails to disclose certain aspects of Applicants' invention as recited in the independent claims, and as a result, does not anticipate (or even render obvious) Applicants' invention.

Abe describes an image forming apparatus capable of producing a pseudo half-tone image by using dither patterns without increasing pixels in the matrix. The dither patterns have different numbers of ON bits corresponding to black pixels, and remaining dither patterns have the same number of ON bits which are different patterns. The dither patterns stored in the storage circuit (14) are matrix patterns which have gradation values determined in accordance with the variations of grey levels which are caused by effects derived from adjacent pixels. Therefore, the gradation values of the dither patterns are determined according to the position of

ON bits regardless of the same number of ON bits. A dither conversion circuit (12) converts multi-level image data to binary image data represented by the dither patterns. The image forming device (2) forms an image according to the binary image data and reproduces the gradations of the dither patterns. (See Abstract of Abe.)

Although Abe describes halftoning, it is respectfully submitted that Abe does not teach or suggest halftoning in accordance with Applicants' recited invention. For example, Abe describes a process wherein a single value from the input image determines the value of every pel in an output dither pattern. It is only within this context that Abe describes an ability to get different output densities for two cells with the same number of printed pels, i.e., arranged differently. Additionally, Abe's claims apply to a halftoning technique where output data is presented that is "binary", i.e., the output data can take on only two values (ON or OFF).

In contrast to the teachings of Abe (wherein an entire output cell is generated from a single input value), Applicants' invention recites, in part, that the number of pels of the first plurality of pels is equal to the number of pels of the second plurality of pels, and further, that n pels of the first plurality of pels contribute to the output intensities of the n pels within each basic cell. As is clear from this language, Applicants' invention is a "one-to-one" approach for halftoning. Abe is a "one-to-basic cell" approach. For at least this reason, Applicants respectfully submit that there is no anticipation of their recited invention based upon the teachings of Abe.

Further, Applicants recite a "one-to-one" halftoning approach wherein the maximum number of densities per each basic cell is greater than $(1 + n \times (L - 1))$ for a full range of constant input intensities (i.e., 0 to K input intensities). The applied art, taken alone, or in combination, does not teach or suggest such a facility.

The dependent claims at issue are believed allowable for the same reasons as their respective independent claims, as well as for their own additional characterizations.

35 U.S.C. §103:

The Office Action further states a rejection of claims 4-7, 13-15, 19-21, 25-27 & 33 under 35 U.S.C. §103(a) as being unpatentable over Abe in view of Sakurada et al. (U.S. Patent No. 4,672,432; hereinafter Sakurada), and a rejection to claims 5, 6, 14, 15, 20, 21, 26 & 27

under 35 U.S.C. §103(a) as being unpatentable over Abe in view of Sugino (U.S. Patent No. 4,897,736; hereinafter Sugino). Each of these rejections is respectfully, but most strenuously, traversed to any extent deemed applicable to the claims presented herewith.

Sakurada is a "one-to-basic cell" halftoning approach (for example, reference column 2 of Sakurada, wherein one pel in determines a basic cell output, that is, that there is a shift in resolution), while Sugino is simply not relevant to this issue.

Since none of the applied art presents a facility for obtaining an enhanced number of density levels for a basic cell in a halftoning approach that is a "one-to-one" resolution approach, Applicants respectfully submit that there is no teaching or suggestion of their recited invention based upon any combination thereof. Further, Applicants note that both Sakurada and Sugino are cited in the Office Action for various characteristics of the dependent claims at issue. Without acquiescing to the characterizations of these patents set forth in the Office Action, Applicants respectfully submit that neither patent teaches or suggests the above-noted deficiencies of Abe when applied against the independent claims presented herewith.

For all the above reasons, Applicants respectfully submit that all claims are in condition for allowance and such action is respectfully requested.

Applicants' undersigned attorney is available should the Examiner wish to discuss this application further.

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